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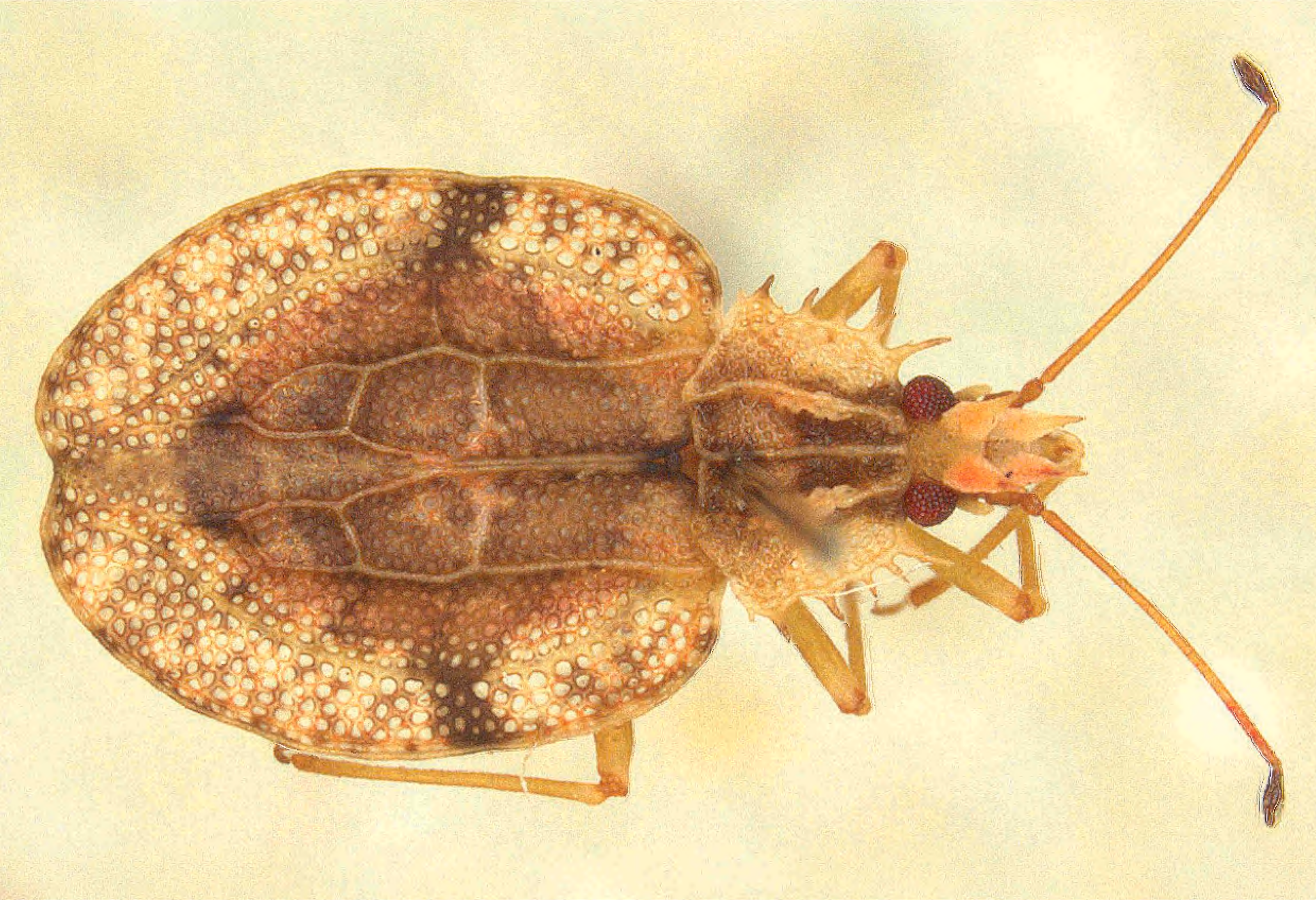

Plants and their role in coextinction

Plants and pollinators - an essential partnership in subtropical rainforest

Regent Honeyeaters and Eucalypt diversity in the Cessnock area of New South Wales

Restoring reserves in the heart of Western Sydney:
habitat reconstruction for the threatened Scarlet Robin

And much much more …

SPECIAL THEME: VALUE OF PLANT CONSERVATION TO ANIMALS

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the December 2013 – February 2014 issue is Friday 8 November 2013.** The theme for the issue will be *Seeds*. General articles are also very welcome. Please contact Selga Harrington if you are intending to submit an article: selga.harrington@gmail.com

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Front cover: Does David Coates' lacebug (*Ceratocader coatsi*), known from a single specimen on a mountain, require active management? We know very little about most of the herbivorous insect species in Australia, the majority do not even have names yet. Photo: M.L. Moir

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From the editor

Selga Harrington
Parsons Brinckerhoff

Welcome to the spring edition of *Australasian Plant Conservation*! The theme for this edition is the 'value of plant conservation to animals'.

The ecology and survival of plants and animals is interdependent. From pollination, to foraging and seed dispersal, to provision of habitat resources, interactions between plants and animals underpin ecosystem functions. In this issue we examine key interactions of plants and animals and the value of plant conservation to animals. The issue includes articles on: the relationship of plants with insects including native bee pollinators; the value of plant conservation and restoration to birds; and the relationship of riparian and floodplain vegetation and environmental flows to aquatic ecosystem health and blackwater events.

This edition also includes an update on field observations of the endangered and data deficient *Pultenaea* sp. 'Olinda' which we read about in the previous issue as well as an article on the Restore and Renew NSW project which aims to provide genetic, environmental and ecological information for species considered as primary targets in restoration projects across NSW.

This issue includes a new segment where we provide a profile on an ANPC member - this issue we talk to David Taylor about his work at the Australian National Botanic Gardens and his restoration work of his own bush block and in his local area. The issue concludes with the regular features: Report from New Zealand Plant Conservation Network; Upcoming conferences; Information resources and useful Websites; and finally the Research roundup.

Happy reading!

Plants and their role in coextinction

Melinda Moir
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Plants act as hosts to many different types of organisms, from fungi and mites to butterflies and birds. For many invertebrates, interactions with plants are important in directly providing food through plant parts (e.g. for herbivorous insects, pollinators, seed predators), indirectly through the animals that visit plants (e.g. for flower spiders, sundew mirid bugs that feed on invertebrates captured by the plant), or shelter (domatia mites, galling insects, leaf-curling spiders). When these interactions become species-specific, then the loss of the plant species could result in the extinction (also termed coextinction) of those invertebrates that rely on that particular plant for survival. The number of cascading extinctions through this mechanism is predicted to be huge.

In this article, I focus on herbivorous insects. Insect herbivores are more diverse than plants; in England for example, they represent 26% of terrestrial diversity, whereas plants contribute 22% (Strong *et al*. 1984). The majority of plant species host at least one species of monophagous insect (only able to feed on a single plant species). The extinction of one plant, therefore, could translate into loss of multiple insect species. Herbivorous insects are predominantly lost before the extinction of their host plant. For example, two monophagous mealybugs, *Clavicoccus erinaceus* and *Phyllococcus oahuensis*, have gone extinct in Hawaii despite their host plants maintaining populations, although one plant is now critically endangered. The insect herbivore is extinguished before the host plant because there is a critical point at which the host population becomes too small to sustain a viable population of insect herbivore. Consider the conservation of any dependent insect species is, therefore, required promptly when a decline in a plant species is first recognized.

Globally, butterflies garner by far the most support in terms of active conservation for herbivorous insects. Within Australia, butterflies also receive the most attention but, very occasionally, other charismatic species manage to steal the spotlight (and conservation dollars), such as the giant Lord Howe stick insect. But what of the vast majority of species, particularly the micro-insects that are generally less than 5 mm in length? Unfortunately, for most groups we don't know what species are out there and therefore struggle to identify which may be threatened; many are undescribed, or known from very few individuals. Consider, for example, the lacebug recently named in honour of the *Australian Network for Plant Conservation* president David Coates; *Ceratocader coatsi*. It is known only from a single specimen collected on conservation listed *Gastrolobium subcordatum* (WA Government: Priority 4), on a mountain in south west Australia. Does it require conserving? Too few surveys have been conducted that specifically target plant-dwelling invertebrates to be able to confidently make a call. Despite the difficulties in identifying invertebrates in need of conservation, we should persist as their extinction could facilitate cascading extinctions, which potentially include losing the plant species as well.

Conservation management options

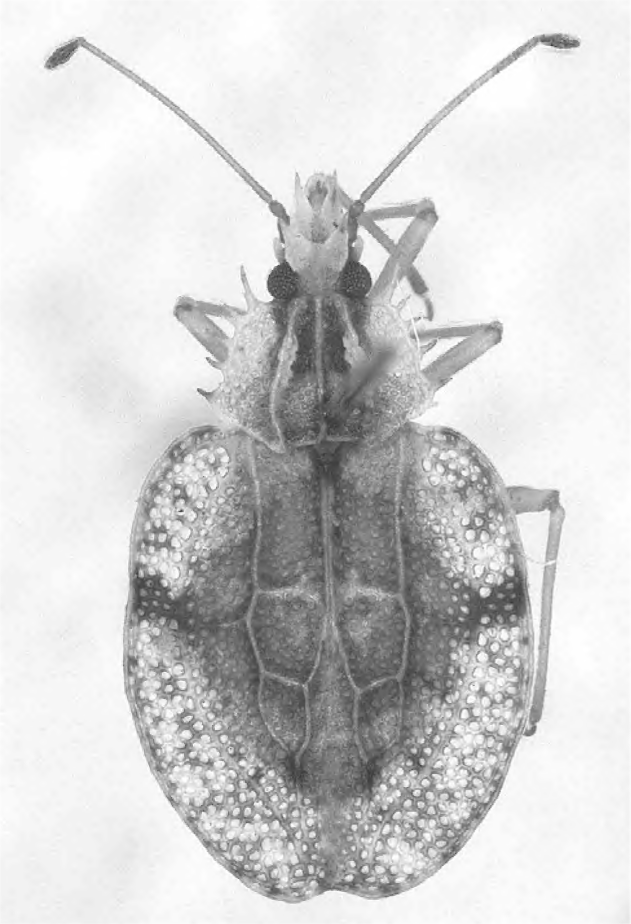
When we do identify invertebrate species in need of conserving, then precautionary action beyond monitoring needs to be taken to assist with their survival. It is insufficient to assume that the invertebrate will survive if we conserve the plant. The survival of the plant is, of course, of foremost importance to herbivorous insects. However, if only the welfare of the plant is considered, then the fate of the insect (and perhaps a multitude of other associated organisms) may be doomed. Ex-situ conservation techniques such as translocations, seed banks, cultivation in botanical parks and even assisted migration do not automatically facilitate the survival of insects, which may not be able to reach these new areas (Moir *et al.* 2012a,b). Restoring threatened communities can increase the potential habitat for both the insects and the plant host (e.g., Hogbin 2012). Having said this, in situ conservation is not the only way forward. Joint translocation can capitalize on the expenditure already invested in the plant conservation program, and with a little extra investment can assist in the survival of multiple species.

Trials of such joint translocations are occurring in the southwest of Australia in partnership with Western Australian Department of Parks and Wildlife (DPaW), formerly Department of Environment and Conservation. The trials include introducing the mealybug (*Pseudoccoccus markharveyi*) onto its critically endangered host plant *Banksia montana*. In addition, translocated individuals of the critically endangered *Banksia brownii* are receiving the equally critically endangered plantlouse (*Trioza barrettae*) (so named after the hard-working DPaW flora officer in this floral biodiversity hotspot, Sarah Barrett). An interesting dilemma has arisen with such joint translocations; when should we introduce the host and insect to the new site to maximize establishment and growth for both populations? Currently PhD student Michaela Plein is working on this question from a modelling perspective.

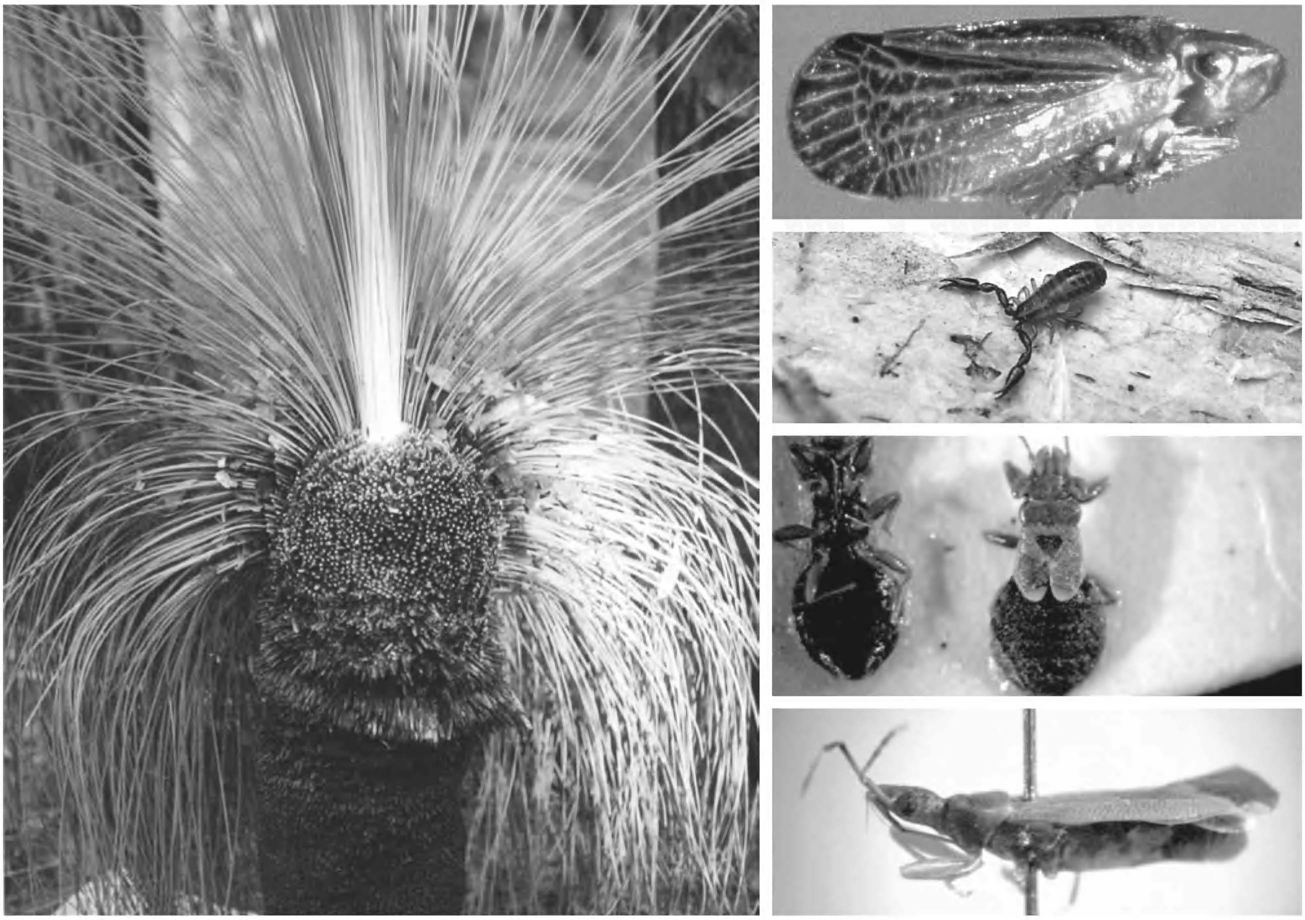
Another management option is the reintroduction of insect species onto naturally occurring populations of host plant that are currently uninhabited by the insect. One of the main dilemmas with this action is whether the herbivore will displace other species at the new site. This option does have multiple benefits, including:

- translocation can be immediate as plants are of a suitable age and structure
- not requiring botanists/land managers to translocate plants (an issue for host plants that do not have "critically endangered" status)
- possible reintroduction into the insect's historic range and therefore potentially more successful due to similar environmental factors
- mitigates threats to the species as a whole by developing new populations away from the source population.

The critically endangered plantlouse (*Acizzia veski*) (IUCN 2013) is currently undergoing such reintroduction trials on populations of its conservation listed host plant *Acacia veronica* (WA Government: Priority 4) in the southwest.



*Does David Coates' lacebug (*Ceratocader coatsi*), known from a single specimen on a mountain, require active management? We know very little about most of the herbivorous insect species in Australia, the majority do not even have names yet. Photo: M.L. Moir*



*Mature grasstrees (*Xanthorrhoea *sp.) are important hosts to many invertebrates such as bugs, beetles, spiders and pseudoscorpions (shown from top is the herbivorous planthopper* Cyptobarsac rubriops*, a predatory pseudoscorpion species, the herbivorous bug* Baclozygum brachypterum *and the blood-sucking bug* Neoclerada westraliensis*). Often these particular invertebrate species do not occur on other plants as they are adapted to the microhabitat or the food source provided by grasstrees (this grasstree has been shaved to demonstrate the dense microhabitat). Photos: M.L. Moir*

General applications for restoration

The majority of current restoration projects focus on returning the plants, but not on active reinstatement of animal species. Some insects may take many years to recolonize restored habitats, if at all. Certain insects with poor powers of dispersal but with close host-specific ties with particular plants could be actively introduced into restored areas by entomologists and land managers. This would increase the similarity of fauna between restored and undisturbed sites, and provide the ecosystem functions offered by these specialist insects (e.g. pollination, herbivory and recycling) (Moir *et al*. 2010).

Conclusion

The road ahead for land managers and conservationists may look daunting, particularly given the overwhelming number of insect species potentially at risk, and the dire predictions of the impact that climate change will have on native plant species. However, considering plants as a part of a network of interacting species is the beginning toward the conservation of approximately 26% of global terrestrial biodiversity - herbivorous insects.

Acknowledgements

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Plants and pollinators - an essential partnership in subtropical rainforest

Geoff Williams[1] and Paul Adam[2]

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Introduction

Despite the increased representation of rainforest in formal reserves since the 1980s (Adam 1987, Kitching *et al*. 2010) many rainforest stands, both within reserves or in private ownership, exist as disjunct fragments. This is particularly the case in the coastal lowland rainforests.

Small patches of rainforest experience all the problems of physically isolated fragments of any community type. Can small rainforest stands remain viable in the long term? Designating sites as reserves, or entering into conservation agreements with private landholders, will not of itself ensure survival, without consideration being given to maintaining ecological processes.

Plant reproduction

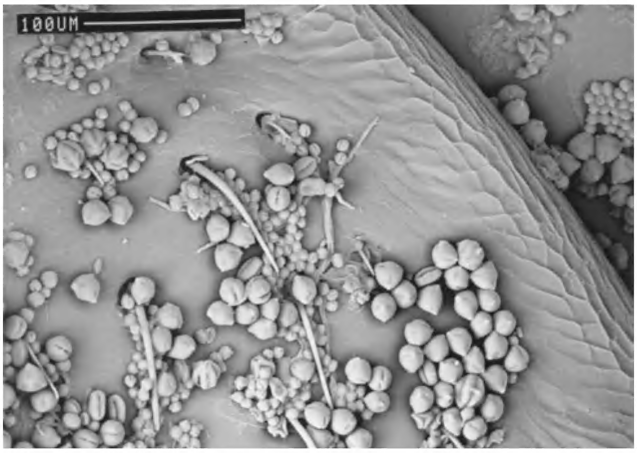
The viability of stands depends on sustaining plant reproduction at the species level, not just maintaining a semblance of rainforest structure and tree cover. To date most management strategies fail to consider the dynamics of recruitment and survival of individual species.

In flowering plants, pollination is essential for seed production. The popular literature and visual media often give the impression that there are many highly specific, often bizarre, pollination systems in rainforest. Whilst there are instances of ecologically specialised plant and pollinator mutualisms, for example in the rainforest understorey and for epiphytic orchids, worldwide these are relatively rare, even in floristically complex tropical rainforests.

Most flowering subtropical rainforest trees and shrubs have small white or cream coloured flowers with open floral structures generally accessible to a range of visitors. Individually, each flower produces only tiny amounts of floral resources that might benefit any insect or other animal that visits.

Most trees, shrubs and vines in subtropical rainforest, are pollinated by generalists, principally small insects less than 5 mm in length that rarely exhibit an obligatory attraction to any one species of flowering plant (Williams and Adam 2010). Such insect dominated generalist pollination systems predominate throughout the world's rainforests.

The major groups of insects participating in generalist pollination strategies are beetles, flies, wasps and bees, though native bees are not as significant as is popularly thought. Many of the participants are relatively inefficient pollinators, and the frequency of movements between and within flowering plants is low. Some flower visitors are thieves, devouring pollen and flower structures with no obvious reproductive benefit to the plant, yet others, such as various large beetles and wasps, and widely foraging solitary bees are important in transferring pollen over large distances. And even small, individually inefficient pollinators compensate by their vast numbers in effecting pollination.



Even apparently smooth shiny beetles can carry pollen – Scanning Electron Microscope image of mixed pollen load on the hypomeron of the beetle Castiarina acuminata *(Buprestidae). Photo: G. Williams*

Flexibility in the recruitment of pollinators provides ecological resilience. Most plants are likely to achieve reliable levels of pollination, and consequent fertilisation, even if certain pollinators become locally extinct or their populations dramatically fluctuate within individual rainforest fragments. The survival of rainforest over geological time reflects this flexibility.

In a species rich community, where individuals of a particular plant species may be at low densities, how do species 'ensure' that sufficient pollen reaches a stigma of the same species and is not lost through dispersal to flowers of different species?

There are two major means by which the odds of successful reproduction are improved:

- At the community level flowers are available for much of the year, although there is a peak spring – summer flowering period; when most invertebrate pollinators are active as adults. This helps to maintain the pool of potential pollinators. However, within particular time windows only a proportion of the plant species will be in flower. In seeking to attract pollinators, a species is not necessarily competing with all other species in the community.

- Success in attracting pollinators is achieved through 'advertising'. Although the flowers of many subtropical rainforest trees are small they are frequently aggregated into inflorescences, and mass flowering throughout the canopy creates a strong visual signal attracting pollinators.

Issues of conservation

Reproductive compatibility

There are significant issues for plant reproduction in rainforest fragments. Not all species are self-compatible so pollen transport between individuals is required for fertilization. Low gene flow between and within populations in isolated fragments in highly modified landscapes is likely to lead to lower reproductive success and heightened vulnerability to environmental perturbations.

Compared with its occurrence in flowering plants as a whole, dioecy (where individual plants are of one sex) is more common in rainforests. In New South Wales dioecious species commonly represent greater than 20% of the woody species in individual coastal remnants (Adam and Williams 2001). Some dioecious species, e.g. female *Alchornea ilicifolia*, may reproduce asexually, others can reproduce vegetatively by coppicing (e.g. *Diospyros australis*). For those species where pollen transfer between separate male and female plants is essential for reproduction, pollen transfer within or between stands is unlikely if:

- the population in a particular stand is reduced to individuals of only one sex, or
- the population is very small with male and female individuals widely separated.

At the population level there may be functional extinction, even if adult longevity masks the inevitability of demise unless there is active management intervention. Unfortunately it may not be possible morphologically to determine the sex of seedlings and saplings, and sexual maturity may not occur for many years, so artificial recruitment by planting is not guaranteed to improve sex ratios.

Even for hermaphroditic species, populations in fragments may be very small, with individual species being represented by only one or two plants. While existing trees may be long-lived, potential recruitment may be highly inbred unless there is gene flow by either pollen or seed dispersal between fragments.

Successful dispersal will depend upon the distance between fragments, and pollinator availability. Even when fragments are close, gene transfer between fragments may be very limited. Artificial transfer of pollen between stands is not likely to be practically feasible, but transfer of seeds, or seedlings, may be feasible – but would require very careful evaluation, and if it were to occur should be fully documented.

Polistes humilus *(Vespideae) on inflorescence of* Alphitonia excelsa. *Photo: G. Williams*

Insect pollinators

There is a great diversity of native bees in subtropical rainforest, though relative to the abundance of other native pollinating insects on flowers, their numbers are often not great.

Introduced honey bees (*Apis mellifera*) are common within rainforest fragments, either from commercial hives or from feral hives located in tree hollows. Their impact on plant pollination in rainforests is uncertain. They frequently mass to flowers during peak flowering events but observations suggest that for canopy dominating trees at least, the sheer number of available flowers means that other potential pollinators can still access some flowers.

The introduced honey bee does not necessarily move between pollen producing and nectar producing plants during flowering events. They commonly exhibit foraging constancy for either resource, and so pollen transfer may not occur to the level that their numbers might suggest. Where they forage at subcanopy levels, and at plants producing fewer flowers, then their impact may be more disadvantageous, and though their great numbers appear not to disturb foraging by larger and more robust native insects, they readily disturb and discourage many native bees, wasps, flies, butterflies, and smaller beetles. How this affects the life histories and conservation status of native insects is largely unknown.

Impacts of weeds on pollination

The extent to which the co-flowering of invading weeds such as lantana, camphor laurel and large-leaved privet, impacts on the pollination of native plants in rainforest fragments, by diverting pollinators, is not well known.

The popularity of rainforest species in horticulture means that non locally indigenous species may be planted in gardens close to remnant stands, potentially competing for a limited pool of pollinators. Such plantings can also adversely impact on threatened fauna; for example exotic *Aristolochia* can be toxic to the larvae of the Richmond River Birdwing Butterfly.

Conclusion

The increase in the area of rainforest in formal reserves, or subject to conservation agreements on private lands, might give a false sense of security about the conservation status of individual species and communities. To reach long term sustainability will require greater attention to be given to maintaining ecological processes within rainforest - and reproductive processes of both plants and pollinators are of great significance.

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Tetragonula carbonaria – pollinator and educator

Peter Clarke

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Introduction

Bees are perhaps humanity's favourite insect. Culturally they are known for their industriousness, their pollinating abilities that substantially increase crop yields and their production of honey, a product that has been in demand for thousands of years.

Tetragonula (*Tetragonula carbonaria*) is a native stingless bee that occurs in southern Queensland and in New South Wales as far south as Bega. They are black with white fur on their faces and sides and are 4mm long. Being a social bee they have a queen, drones, workers and many thousands of them share a hive. *Tetragonula carbonaria* are the only social bee found as far south as Sydney, and although Sydney is towards the southern end of its range, it is still a common native insect there, in areas that retain some native vegetation.

WildThings is a Ku-ring-gai Council program that focusses on urban wildlife and one of its main initiatives is the placement of Tetragonula hives on residential properties throughout Ku-ring-gai, a local government area approximately 12 km from the centre of Sydney. This program is very popular with residents and although over 250 hives have been successfully distributed there is still a waiting list of over 100 people.

Changing attitudes with the Tetragonula program

The Tetragonula program works on a number of levels. Its primary purpose is to connect people with a native insect. The concept at its most basic is that if you understand something then you won't mindlessly kill it. Most urban Australians have an irrational fear of insects, and are constantly bombarded with advertisements that focus on killing any insect that has the temerity to get close to human habitation. Effective control of insect pests such as termites, cockroaches and mosquitoes etc. is important, however most of the methods used to eliminate pest species have the unfortunate consequence of dealing considerable collateral damage to beneficial insects such as native bees.

In my experience residents who receive a Tetragonula hive are much less likely to use insecticides and are also more open to adopting a less hostile attitude to insects that they are ignorant about. They develop a 'wait and see if it's a problem' attitude rather than immediately unleashing the chemical warfare option.

The Honey Bee and its threats

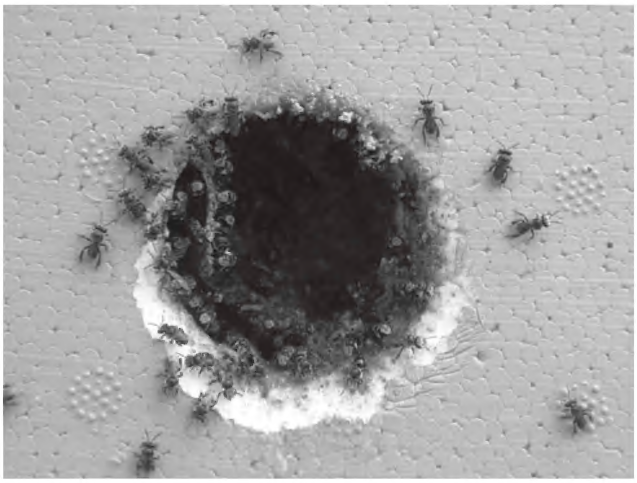
Until recently most Sydneysiders thought the Honey Bee (*Apis mellifera*) was an Australian native insect. This introduced insect obviously helps with crop yields, and makes copious amounts of honey but unfortunately has spread throughout the Australian continent, occupying tree hollows and similar spaces to the detriment of native wildlife.

The Honey Bee is under threat from a number of pests and an unknown syndrome. Currently the main pest is the African Small Hive Beetle (*Aethina tumida)* which was first identified in Australia in 2002. This pest has decimated feral and managed Honey Bee hives in Sydney to the extent that feral hives are becoming uncommon in the Sydney area and I would assume in other areas where the beetle is prevalent.

Varroa mites (*Varroa destructor* and *Varroa jacobsoni*) are parasitic mites that feed on the bodily fluids of adult, pupal and larval Honey Bees and are potentially another massive problem. Although not yet found in Australia these pests are believed to have even more damaging potential than the Small Hive Beetle and most experts consider it is only a matter of time before they arrive in Australia.

Colony Collapse Disorder (CCD) is the unknown syndrome and causes bees to abandon their hives. CCD occurs primarily in the USA and Europe with hive mortality rates of 28 to 33%. This has yet to hit Australian shores, however because the cause of the problem is unknown there is a possibility that it will eventually effect Australian Honey Bee hives.

Native stingless bee, Tetragonula carbonaria*.*
Photo: James Niland



Tetragonula at hive entrance. Photo: Peter Clarke

Pollination and productivity

Plants are pollinated in myriad ways: insects, vertebrates, wind etc. and if the Honey Bee disappeared tomorrow, crop yields would definitely be down. It is probably a good idea not to over rely on any one pollination vector. Native bees are relatively unaffected by any of the threats currently facing the Honey Bee and therefore could be very useful to the agricultural sectors.

There has not been a lot of work done regarding the pollinating abilities of native bees, however, there are several papers that show Tetragonula to be efficient pollinators and by implication underused by food producers (Exley, 1988; Ibaraki, undated; Wallace and Trueman, 1995). With the Honey Bees facing an unknown future, stingless native bees such as Tetragonula could be a very useful alternative.

Comparison of Honey Bee and Tetragonlula productivity and foraging range

	Honey Bee	Tetragonula
Productive temperature band	13-38°C	18-38°C
Foraging range	3-9 kilometres	0.5-1 kilometres
Annual honey production per hive	20-25 kilogramss	0.5 kilograms

The Honey Bee has some obvious advantages over Tetragonula in terms of productivity including productive temperature range and annual honey production. However being stingless, Tetragonula have a lot of appeal to people who risk anaphylactic shock from a Honey Bee sting, or are just afraid of bee stings generally.

Tetragonula are known as generalist pollinators, meaning that they take advantage of multiple plant species in their quest for sustenance. This makes Tetragonula suitable for a range of areas including those dominated by exotics and weeds, such as the vast majority of urban gardens.

Being a small bee many native flowers are effectively pollinated by Tetragonula with anecdotal evidence that Honey Bees bypass pollinating flowers of species such as *Lambertia formosa* by accessing the flower at its base and avoiding its sexual parts. Tetragonula definitely play an important role in Australian ecosystems and their long term survival in urban areas will rely on them being better recognised by the urban population.

Conclusion

The WildThings Tetragonula initiative has had some unexpected benefits. The general awareness of this native bee has increased resulting in the rescue of many hives that would otherwise have gone through a wood chipper. It has also brought together a large group of people who have joined WildThingsNSW (http://bit.ly/16FMzXi), an organisation dedicated to the preservation of urban wildlife. In the last year the organisation grew to 155 paid members.

Plant conservation is very important but it is easy to just focus on plants and overlook some of the unsung ecological heroes such as Tetragonula. These native bees are a vital component of a healthy ecosystem and the WildThings program can rightly be proud of the work it has done to promote these engaging insects, even though benefits to plants were a secondary consideration when the initiative commenced.

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Tetragonula hive showing the egg mass and honey and pollen pots. Photo: L. Gibson

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Regent Honeyeaters and Eucalypt diversity in the Cessnock area of New South Wales

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The Regent Honeyeater (*Anthochaera phrygia*) is an endangered species of honeyeater that occurs in Eucalypt-dominated open forests and woodlands from south-east Queensland to Central Victoria (and formerly into South Australia where it is now considered extinct). It is listed nationally as 'Endangered' and as 'Critically Endangered' within New South Wales (NSW) due to critical decline in numbers and area of occupancy. It is generally accepted that the total population of Regent Honeyeaters is fewer than 1000 birds, possibly much less.

Occurrence within Cessnock Local Government Area

Regent Honeyeaters occur regularly within the remnant forested areas within the Cessnock Local Government Area (LGA), within a 20 km radius of Kitchener (32° 52' 10" S, 151° 22' 12" E e.g. Roderick & Ingwersen 2012). The area is considered crucial to the viability of Regent Honeyeaters both as an adjunct to the Capertee Valley breeding area and as an important area in its own right (Ingwersen *et al* in prep; Roderick *et al* 2013).

Preferred habitat- Spotted Gum Forest

In this area, Regent Honeyeaters occur sporadically within dry open forests in association with the seasonal blossoming of winter-flowering Eucalypts. These forests are generally dominated by Spotted Gum (*Corymbia maculata*), Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Grey Gum (*E. punctata*). However, the diversity of Eucalypts in the area is considered to be very high and botanical studies in the area have recorded up to 43 species of Eucalypt, comprising 35 Eucalyptus (including 2 undescribed species), five Angophora and three *Corymbia* species (DECC 2008). This represents an astonishing diversity in such a small area (<400 sq. km). In fact, a single remnant patch of bushland (the Hunter Economic Zone; HEZ) was found to contain 29 species, including both of the undescribed taxa, within a 3000 ha area (Bell 2004) and has been recognised as a high priority conservation area that contains complementary World Heritage Values to the Greater Blue Mountains World Heritage Area in the Cessnock LGA (Parsons Brinckerhoff 2013).

The reasons for this high diversity of Eucalypts are not known, but it is worth noting that Cessnock is at the junction of the Sydney Basin and North Coast IBRA bioregions and that the area forms the limit of distribution for many plant taxa (in all compass directions). Given that Regent Honeyeaters occur almost exclusively in habitats dominated by Eucalypts (see Higgins *et al* 2001), the high diversity of Eucalypts could be a factor in the significance of the Cessnock forests to Regent Honeyeaters. The fact that the forests occur in large vegetated remnants on the floor of the Lower Hunter Valley is likely to also be a major contributing factor as the forests occur on fertile soils in an over-cleared landscape (and hence contain fauna species, such as the Regent Honeyeater, associated with fertile soils).

Predominantly, it appears to be the prolific blossoming of Spotted Gum that attracts Regent Honeyeaters to the Cessnock area in high numbers. This occurs on a cyclical basis, as Spotted Gums do not flower en-masse every year. In recent times, significant numbers of Regent Honeyeaters have been recorded in the Cessnock area during 2000, 2003, 2007, 2009 and 2012. During 2012 at least 100 Regent Honeyeaters were recorded in the Cessnock area, constituting the maximum known concentration of the species anywhere across its range since 2005 (which was in the Capertee Valley) and comprised a significant proportion (probably >10%) of the total population of the species.

Importance of other species for foraging

Apart from the availability of Spotted Gum, Regent Honeyeaters have been observed feeding in the blossom of other Eucalypts in the Cessnock area such as Forest Red Gum (*Eucalyptus tereticornis*) and Broad-leaved Ironbark (*E. fibrosa*). They have also been observed feeding in Eucalypts that have not been previously documented as feed trees. These include the blossom of *Eucalyptus fergusonii* ssp. *dorsiventralis* (Rare or Threatened Australian Plant, ROTAP rating 2RC) and an undescribed species of stringybark, *E.* sp. aff. *agglomerata.*

Regent Honeyeater - listed nationally as Endangered and as Critically Endangered within New South Wales. Photo: Allan Richardson

The identification of stringybark trees that have been used regularly by Regent Honeyeaters in the Cessnock area is complex. Trees in the Kitchener / Ellalong / Paxton area have been identified as appearing more like Brown Stringybark (*E. capitellata*) and it is uncertain which species these trees belong to. They have also been recorded for several years in tall stringybark trees along a drainage line in the Quorrobolong area, which show more affinities to *E. agglomerata* but again, which have not been identified to date. In other areas, Thin-leaved Stringybark *(E. eugenoides)* has been tentatively identified as trees where Regent Honeyeaters have been found feeding.

Another Eucalypt-related food resource occurs in the area in the form of Long-flower Mistletoe (*Dendropthoe vitellina*) plants. These mistletoe clumps are abundant in the Cessnock forests and are predominantly hosted within Spotted Gum trees. However, Regent Honeyeaters have been observed foraging on the blossom of Long-flower Mistletoe plants within Narrow-leaved Apple (*Angophora bakeri*) trees (M. Roderick; S. Roderick; A. Richardson pers. obs.).

Breeding

Regent Honeyeaters have bred on several occasions in the area, usually when other blossoming occurs in spring-flowering Eucalypts. In late 2007, a successful "semi-communal" breeding event took place on industrial-zoned land within the HEZ. This area was likely used as a breeding locality in the past (A. Zoneff pers. comm.). Nests were located within Broad-leaved Ironbark and Grey Gum trees and/or within Narrow-leaved Mistletoe clumps (Biosis Research 2008). This represented one of the most important and successful known breeding events for Regent Honeyeaters in recent times and further highlights the significance of the Cessnock area to underpin recovery efforts for the species.

Conclusions

The Eucalypt-diverse open forests of the Cessnock area are regularly used by Regent Honeyeaters and are of crucial importance to this critically endangered species, both in terms of providing an essential winter food source and significant opportunity for birds to breed. The area is recognised as being of high conservation value generally and the significance for Regent Honeyeaters cannot be understated. Recent strategic planning assessments have recommended that areas of high conservation value not currently protected be considered for conservation. Further work should be undertaken to clarify the taxonomic and conservation status of the various stringybark species known to be used regularly by Regent Honeyeaters in the area.

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Regent Honeyeater feeding on blossom at Kurri Kurri. Photo: Mick Roderick

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Woodland bird communities in a revegetation area at Snape Reserve, Victoria

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Introduction

Snape Reserve is a 754 ha situated near Dimboola in the Wimmera, Victoria. After a chequered history, Trust for Nature purchased the partially cleared property in 2002. Although many of the cleared areas were naturally regenerating, a large area in the north-east of the property remained largely bare of native vegetation. A single Buloke (*Allocasuarina luehmannii*) remained the only feature in this otherwise open paddock. The Snape Reserve management committee, in conjunction with Greening Australia, revegetated the site in 2003/04. The revegetation area provided connectivity between two existing remnant areas.

The original vegetation communities in the area, as defined by their Ecological Vegetation Classes (EVCs), were Low Rises Woodland and Shallow Sands Woodland. These similar vegetation communities are both dominated by a tree overstorey of Yellow Gum (*Eucalyptus leucoxylon*), Buloke and Slender Cypress-Pine (*Callitris gracilis* ssp. *murrayensis*). Low Rises Woodland can also contain Grey Box (*E. microcarpa*). The benchmark understorey species for these two EVCs include various small to medium shrubs (1–3 metres tall) including wattles, such as Golden Wattle (*Acacia pycnantha*), bush-peas, such as *Eutaxia microphylla*, plus a ground layer of medium and small herbs, and a 25% cover of native grasses (www.dse.vic.gov.au/conservation-and-environment/native-vegetation-groups-for-victoria/ecological-vegetation-class-evc-benchmarks-by-bioregion/evc-benchmarks-wimmera-bioregion).

In 2004, the Wimmera Catchment Management Authority (WCMA) established the Wimmera Bird Monitoring Project, a community-based project which used bird surveying as a basis for monitoring biodiversity across the Wimmera (Starks 2013). As part of this project, Snape Reserve was identified as an ideal location to monitor bird population change in an area undergoing revegetation.

Methods

Eighteen hectares of the reserve were direct seeded and planted with tubestock. Species were selected from the EVC benchmarks and from Snape Reserve plant lists. Tree species chosen were Yellow Gum, Buloke and Slender Cypress-Pine. Understorey species reflected those in adjoining mature woodland and were mainly Golden Wattle, Grey Mulga (*A. brachybotrya*), Gold-dust Wattle (*A. acinacea*), Desert Cassia (*Cassia nemophila*) and Weeping Pittosporum (*Pittosporum angustifolium*). Some low herbs, including Ruby Saltbush (*Enchylaena tomentosa*) and, and various native grasses have self colonised.

The bird survey methodology used by the Wimmera Bird Monitoring Project was the BirdLife Australia 20 minute/two hectare search approach (see Barrett *et al*. 2003). Surveys were undertaken for five years, between 2008 and 2012. It was planned that surveys would be undertaken monthly, but for various reasons some months were missed. Species presence and activity (foraging, flying over or perched in the Buloke) within the 2 ha study area was noted. Bird populations were measured by species richness (the number of species recorded per survey) and by relative abundance (the number of times a species was recorded divided by the total number of surveys, expressed as a percentage).

Results

When bird surveying commenced in 2008, the planted species had grown to a shrubby layer one to two metres tall. Yellow Gum had grown up to two metres tall and had foliage to near ground level. The Buloke and Slender Cypress-Pine were still spindly and mostly under 1.5 m tall. The shrub layer had developed to approximately 1 metre height. Most plants still stood as individual plants, with little or no overlapping foliage. The lone Buloke still stood proud.

By the end of 2012, now nine years old, the planted eucalypts are up to six metres tall, second generation wattle seedlings are growing between the planted rows and the Buloke now 'blends in' with the developing tree canopy layer. Foliage from both the trees and shrubs were 'connecting', and many of the Yellow Gum were developing bare trunks.

Aerial view of the revegetation site in 2004, shortly after planting, with the lone Buloke in the centre. Photo: WCMA

Revegetation site in 2008, after 5 years growth and at time when bird monitoring began. The Buloke (centred) is now partially obscured by the revegetation growth. Photo: Sue Smith

Bird surveys conducted to 2012 recorded 57 species within the 2 hectare monitoring site. The results show a gradual increase in mean species richness over the five years of surveying, from less than six birds per survey in 2008 and 2009 to nearly ten birds per survey in 2011. A decrease was recorded in 2012, but this was a very dry year, in contrast to the wet years of 2010 and 2011. Much of the increase is due to a greater number of birds foraging at the site.

The results also reveal how changes in vegetation structure of the revegetation site influences the abundance of individual species. All species became less abundant in 2012, a dry year.

Weebills, a foliage-gleaning species, were consistently recorded in the foliage of Yellow Gum saplings from 2008, when the trees were only five years old and less than 2 metres tall. Superb Fairy-wrens usually inhabit thick understorey which provides foraging, shelter and breeding habitat (Higgins *et al*. 2001). They were already present at the site at 5 years old but increased nearly four-fold between 2008 and 2010, invariably occurring in or around the wattle shrubs.

Ten most frequently recorded species at the Snape Reserve revegetation site, showing reporting rates (percentage of sightings out of total number of surveys) for each survey year.

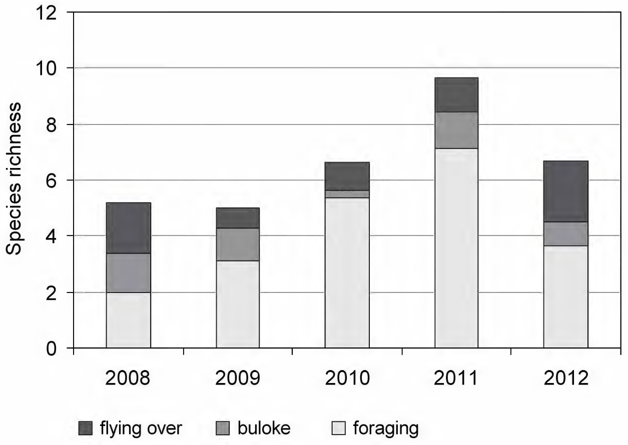
Bird species		**Year (number of surveys)**				
		2008 (n=10)	**2009 (n=11)**	**2010 (n=8)**	**2011 (n=9)**	**2012 (n=6)**
Weebill	*Smicrornis brevirostris*	100	90.9	100	100	66.7
Superb Fairy-wren	*Malurus cyaneus*	22.2	54.6	87.5	77.8	66.7
Yellow Thornbill	*Acanthiza nana*	0	9.1	87.5	66.7	16.7
Galah	*Eolophus roseicapilla*	44.4	18.2	12.5	44.4	66.7
Australian Magpie	*Gymnorhina tibicen*	11.1	9.1	0	100	0
Inland Thornbill	*Acanthiza apicalis*	11.1	27.3	37.5	22.2	16.7
Common Bronzewing	*Phaps chalcoptera*	0	27.3	25.0	22.2	16.7
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	11.1	9.1	25.0	44.4	16.7
White-browed Babbler	*Pomatostomus superciliosus*	22.2	27.3	25.0	22.2	16.7
New Holland Honeyeater	*Phylidonyris novaehollandiae*	0	9.1	0	55.6	16.7

Galahs were only ever recorded flying over the site. Australian Magpies showed no clear pattern of usage. They were recorded infrequently in 2008 (flying over) and 2009 (foraging on the ground), and absent in 2010 and 2012. They were recorded in every survey in 2011, mostly perched in the Buloke.

Common Bronzewings are ground foraging seed-eaters and were first observed in 2009, often flushed from patches of wattle shrubs, and were probably feeding on wattle seeds. White-browed Babblers were recorded fairly consistent throughout the five years of surveying. This species prefers habitat containing a low to medium, fairly dense shrub layer, where they forage in shrubs and among litter on the ground (Higgins & Peter 2002). The results suggest that understorey cover and litter accumulation was already sufficient for this species five years after planting.

Discussion

The results show the success of the WCMA's Wimmera Bird Monitoring Project in demonstrating that a revegetation site can provide functioning habitat for woodland birds within five years of planting, and that as a revegetation site matures, the biodiversity levels increase. These findings are supported by similar studies (e.g. Loyn *et al*. 2007; Martin *et al*. 2011) in showing that the developing canopy, understorey and ground layers in a revegetation site can support an increasing diversity of birds with a wide range of habitat requirements. Revegetation does however, attract generalist or edge species capable of exploiting a range of natural and disturbed habitats, while supporting few species with specialized habitat requirements (Ryan 2000). Martin *et al*. (2011) suggested that bird communities around Wagga Wagga would benefit from integrating revegetation programs with the retention of remnant vegetation and paddock trees. The Snape Reserve revegetation planting forms part of an integrated management plan to restore and enhance the biodiversity values of the reserve.



Mean number of birds recorded per year (species richness) at the Snape Reserve revegetation site, with mean number of birds foraging, perched in the Buloke and flying over the site are shown.

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Restoring reserves in the heart of Western Sydney: habitat reconstruction for the threatened Scarlet Robin

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Introduction

Greening Australia, Parramatta City Council and Cumberland Bird Observers Club collaborated on a small but significant restoration initiative to restore foraging habitat for woodland bird species recorded in a refugia within Western Sydney. The works sought not only to establish immediate foraging habitat for a poorly understood and threatened bird species, the Scarlet Robin (*Petroica boodang*), but likewise provide some insight as to its and other woodland birds' ecological requirements. Works undertaken involved creation of foraging 'islands' to meet the niche seasonal foraging patterns of Scarlet Robin and more generally the diverse requirements of a suite of small insectivorous woodland birds. The islands included three treatments: log piles with shrubs, log piles with grasses and log piles with no accompanying vegetation. Additional scattered canopy species and shrubs were planted to create 'stepping stones' and close large gaps in the formerly open pasture.

Background

The State of Australia's Birds Report 2009 suggests that 50% of woodland birds could be extinct by 2050. Urban remnants and refuges play an increasingly important role in reducing biodiversity loss and providing habitat for diverse species within a city environment. Waddangalli Woodland is one such remnant. It is a 14.7 ha reserve zoned as E2 Environmental Conservation Zone (DOP, 2009) occurring within Parramatta Local Government Area (LGA), in Western Sydney. The area had been actively farmed since the mid 1900s and is currently managed by Parramatta City Council. The site includes restoration and regeneration zones of mixed remnant Cumberland Plain Woodland (an endangered ecological community) and cleared pastures (7.4 ha), along with unmanaged dense woody weed infestations (8.3 ha). A single site inspection in October 2012 detected 36 bird species including two unusual species not recorded commonly in urban habitat, the Satin Flycatcher (*Myiagra cyanoleuca)* and a juvenile White-bellied Cuckoo shrike (*Coracina papuensis*). These two woodland dependent species, along with instances of Scarlet Robin recorded in Parramatta Snapshot Fauna Surveys Report 2012 suggest this reserve provides valuable bird habitat in the Parramatta LGA and could be utilised by many other declining woodland bird species (e.g. Varied Sittella (*Daphoenositta chrysoptera*)) as an urban refuge and for seasonal movements across the Sydney region.

Top: Collecting and transporting logs. Bottom: Log installation. Levelling in prepared areas. Photos: Chris Macris

Many woodland bird species have specific spatial attribute requirements including patch sizes of 10-100 ha, large compact woodland (as opposed to narrow corridors) and a varied landscape matrix of mixed age trees, open grasslands to dense shrubs and accessible logs and branches for perching and foraging. Although this description focuses largely on the habitat requirements of the Scarlet Robin the attributes of the site and restoration design support an array of insectivorous species of woodland birds.

Scarlet Robin is an altitudinal migrant, which forms monogamous pairs. It feeds on invertebrates and has variable foraging, which occurs both at the ground layer (pouncing) and in open air (snatching and hawking) (Major, 2013; Miller, 2013; Robinson, 1992). Some research suggests foraging patterns are seasonal, with snatching and hawking occurring in warmer months (Robinson, 1992) and requiring open woodland and grassland. Pouncing by contrast is suggested to require tree forks, low shrubs and branches for perching, with ground foraging occurring amongst logs and coarse woody debris (OEH, 2010).

Methods

From May to July 2013, Greening Australia staff worked in collaboration with Parramatta City Council to install foraging habitat in two cleared areas (Zone A and Zone B) dominated by exotic pasture grasses (primarily African Love Grass: *Eragrostis curvula*). A total of 1.6 ha of cleared area was revegetated using 2250 planted Cumberland Plain grasses, 120 shrubs and 40 canopy species.

All shrubs and canopy species of local provenance and grown by the Parramatta City Council community nursery. Grasses were supplied by Greening Australia's Richmond production nursery and were Cumberland Plain provenance. Species included:

- Grasses: *Themeda triandra* in six, five metre diameter circles
- Shrubs: *Bursaria spinosa, Dillwynia sieberi*, *Acacia linearifolia*, *Melaleuca thymifolia* and *Indigofera australis* installed amongst logs islands and in clusters of four to create stepping stones through the area
- Trees: *Eucalyptus longifolia* and *Eucalyptus fibrosa*. Scattered at 5-10 metre spaces through Zones A and B.

In addition to revegetation, 72 logs of varying sizes up to 700 kg were installed as a series of islands. Logs were all sourced from Western Sydney, had bark intact and were frequently in early stages of decomposition, to encourage invertebrate colonisation.

Grassy log pile in Area A. Photo: Chantelle Doyle

The log islands had three unique treatments, replicated four times each across the two restoration zones. These were:

- logs in close proximity to open areas (four in total, three in Zone A and one in Zone B)
- logs in close proximity to grass patches (four in total, three in Zone A and one in Zone B)
- logs in close proximity to one by one metre shrubby quadrats (four in total, three in Zone A and one in Zone B).

Additionally, star pickets were installed in both zones to act as false perches - fast tracking opportunities for woodland bird species who exhibit pouncing foraging.

Conclusions

Given most of the information about Scarlet Robin foraging comes from studies of populations on the northern tablelands, the preferences of individuals using this reserve were unknown. Habitat islands were therefore designed to facilitate monitoring of preferred foraging conditions and will provide answers informing future habitat reconstruction works which will achieve 10 ha of connected habitat within the site. Long term monitoring of the site is being conducted by Cumberland Bird Observers Club in association with Parramatta City Council to record bird sightings in the area and to identify any preferential foraging patterns of woodland species. Information gleaned from this study will not only be used to inform future habitat restoration works in Western Sydney but may likewise be of benefit in guiding the direction and method of similar programs conducted as part of restoration and regeneration programs across Australia. It is hoped that this project will set a precedent for the benefits of carrying out highly informed restoration initiatives with clearly quantifiable ecological outcomes.

Acknowledgements

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Plant conservation – for the birds?

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Greening Australia (GA) has been working in native vegetation management and restoration for over thirty years. In the ACT region one of the most widespread vegetation communities is box-gum grassy woodland. This is also one of the most extensively cleared vegetation communities and as such is the focus for much of GA's work in native vegetation restoration in the region.

Birdwatch

In 1999, after the Decade of Landcare when thousands of native trees and shrubs had been established on farmland and hundreds of hectares of remnants had been fenced, GA began investigating the environmental benefits of this plant conservation work for fauna, specifically birds. The 'Birdwatch' study used 133 sites across the ACT and southern tablelands of NSW. Ninety-five of these were revegetated sites, of which 56 were established by direct seeding, and 39 were planted tubestock. The remainder of the sites were made up of 28 remnant woodlands and 10 paddock control sites. Volunteers from the Canberra Ornithologists Group were enlisted to undertake the bird surveys following standard methods used for the Atlas of Australian Birds.

First survey

After the first year of surveys in 2000 an impressive total of 102 bird species had been recorded using revegetated sites. The most frequently recorded species were small insectivores such as the Superb Fairy-wren, Grey Fantail, Silvereye and five species of thornbill. The bird community of revegetated sites (both direct-seeded and planted sites) differed significantly from that of remnant woodlands and paddock sites.

The remnants tended to be dominated by larger-bodied birds such as parrots, cockatoos, Australian Magpie, and the larger honeyeaters, Red Wattlebird and Noisy Miner, but also supported species such as treecreepers which are dependent on fallen timber and well-developed tree trunks. These sorts of resources, along with hollows, dead limbs, mature bark, abundant nectar and seeds are usually not available in young revegetated sites.

Many of the small insectivores appeared to prefer the revegetated sites to remnants, because of the greater structural variety provided by shrub species and young trees or because of the greater health and vigour of the young vegetation compared to some of the dieback-stricken remnants. Particularly encouraging was the presence in revegetation of a number of threatened or declining woodland birds such as Diamond Firetail, Speckled Warbler, Superb Parrot and Southern Whiteface.

A vegetation assessment and analysis of structural and landscape attributes of the sites found that more bird species were recorded in the older revegetated sites and those that were larger, block-shaped rather than linear and had greater structural variation in the height and density of the trees, shrubs and ground layer.

A 2003 study by ANU Honours student Suzi Bond recorded more than 40 species of birds breeding in the revegetated sites demonstrating that these sites could act as source habitat for new generations of many bird species.

Birdwatch 2 and 3

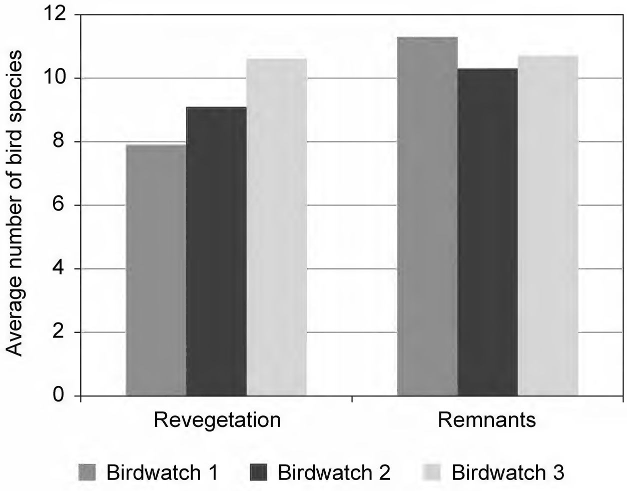
The Birdwatch surveys were repeated in 2008-09 (Birdwatch 2) to investigate changes in the bird community after a further eight years of growth in the revegetation. The intervening years had been particularly dry and this had impacted on the revegetation in a number of ways. Many of the fast-growing acacias had succumbed to the drought while the eucalypts had generally survived. This lead to a more open understorey at many sites and was reflected in a decrease in a number of bird species such as the Superb Fairy-wren, Brown Thornbill, Silvereye and the introduced Common Blackbird which prefer a denser, moister vegetation.

The Red-capped Robin, one of the declining woodland bird species found in revegetated sites on farms. Photo: Geoffrey Dabb

However many more species increased in occurrence in the revegetated sites. These ranged from common birds of the agricultural landscape, such as Crested Pigeon and Galah, through to declining species such as Red-capped Robin and Scarlet Robin. Species richness had increased significantly in the revegetated sites but in the remnant sites it was slightly lower (although not significantly) than in the first surveys.

Birdwatch 3 in 2011-12 repeated the bird surveys again as well as the vegetation assessment first carried out 12 years previously. In a complete contrast to the previous period, the years 2009-2011 were some of the wettest on record. Some of the understorey species were resprouting in the revegetated sites and overstorey height had increased rapidly. The frequency and abundance of birds in these sites had increased by more than one-third since the first surveys, whereas the bird community of remnant sites remained fairly stable (see Figure 1).

Looking at the change in vegetation between 2000 and 2012 and the change in the bird community at the same sites over that time, the most significant vegetation attribute explaining increased species richness was the increase in cover of the 'tall shrub' layer, that is the vegetation layer between 4-8 metres in height.



The average number of bird species in revegetated sites and remnant sites in Birdwatch 1 (2000-01), Birdwatch 2 (2008-09) and birdwatch 3 (2011-12).

Can plant conservation be done better for the birds?

In terms of conservation of native birds in the grassy woodland regions, the Birdwatch project has investigated the value of native vegetation structure rather than looking specifically at plant species. All the revegetated sites were composed of native plant species, with all the eucalypt species of indigenous origin but not all of the acacia species being local to the region, particularly in the older sites.

Although there was no analysis of the effect of plant species it could be seen that many birds species were not disadvantaged by the presence of non-indigenous native plants and would feed opportunistically on non-local species or even introduced plants.

However, other bird species are very reliant on certain aspects of the woodland vegetation. For example the Glossy Black-Cockatoo's diet is mostly made up of the seeds of *Allocasuarina verticillata*; the Mistletoebird and Painted Honeyeater rely on mistletoe fruit; migratory nectar-feeders such as the Swift Parrot and Regent Honeyeater, depend on the flowering of local eucalypts such as *Eucalyptus albens, E. melliodora*, *E. sideroxylon*.

There is a suite of threatened woodland birds, particularly those which feed on the ground, for which a correlation has been shown between occupancy and the level of native ground cover particularly of forb species (Barrett *et al* 2008, Montegue-Drake *et al* 2008). However it is not clear whether this is a relationship between the structure of the native ground layer or the actual plant species. Would restoration of an introduced ground layer to a native one rich in forb diversity provide greater habitat for woodland birds?

The restoration of tree and shrub layers has been practiced for several decades but restoring native ground cover faces multiple challenges, from weed invasion, grazing by stock and pests, elevated nutrients, lack of propagules and scale of operation. Some progress has been made in ground layer restoration by Greening Australia, CSIRO and several universities, however much of it is still in the experimental stage and is not achievable at large scale yet.

Conclusion

Plant conservation efforts to date have proved very effective in assisting the conservation of woodland birds in the grassy box woodlands. Continuing efforts in trying to restore the whole of the grassy woodland vegetation community may well have additional benefits for the woodland bird community as well.

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Understanding blackwater events in rivers

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Rivers and their adjacent riparian and floodplain vegetation are inextricably linked. The littoral zone at the river channel edge supports a narrow band of emergent and submerged plants that forms an important refuge for many animals and is often a place of high biodiversity. The broader floodplain is an essential driver of aquatic productivity and recruitment of biota. Periods of high flow or flooding drive the seasonal exchange of water, nutrients and organisms between the floodplain and river channel and its tributaries, which is a major determinant of aquatic ecosystem function (i.e. the *Flood Pulse Concept*).

Importantly, the major vegetation types of riverine floodplains, such as eucalypts like river red gum (*Eucalyptus camaldulensis*) and black box (*Eucalyptus largiflorens*), form much of the detrital material that fuels aquatic productivity. For example, river red gum leaves are shed continuously, are slow to decompose, and support nutritious, bacteria-rich biofilms which are fed on by grazing snails and other aquatic species. However, the timing and quantity of delivery of these leaves can, at times, be problematic and even catastrophic to aquatic fauna, when they may also fuel blackwater events.

What are Blackwater events?

Blackwater is the term given to river waters that contain high levels of dissolved organic carbon, as they typically turn a characteristic black or dark brown colour during these events. Most dissolved organic carbon in river systems occurs as a consequence of riparian and floodplain leaf litter being washed into the water body. Although this occurs naturally, prolonged dry periods such as those caused by severe drought and/or anthropogenic uses which alter the frequency of flooding, can lead to a significant build-up of leaf litter (i.e. organic material) around rivers and heighten the chance of blackwater events occurring and/or their severity.

Why do they occur?

The two most important factors influencing the development of blackwater events are the temperature of the water (i.e. they usually occur in late spring-summer when waters are warmer) and the amount of carbon (e.g. leaf litter and woody debris) present. Thus blackwater events typically occur as a result of inundation and flooding of areas with high loads of organic matter (i.e. leaf litter), which leads to a high level of organic carbon being introduced to the river system. Naturally occurring bacteria rapidly consume the dissolved organic carbon that is suddenly made available. This increased microbial activity leads to hypoxic conditions as the available oxygen in the water is used at a higher rate than it can be replenished (Hladyz *et al.* 2011). The likelihood and length of time it takes for hypoxic conditions to occur during blackwater events relies on the leaf litter load of the flooded areas and temperature. Laboratory studies have found that inundation of areas with low litter loadings (e.g. 370g/m^{-2} – about half to one-quarter of that recorded in field observations) can lead to dissolved oxygen levels falling to zero within two days (Hladyz *et al*. 2011).

What do they do?

The hypoxic water conditions caused by a blackwater event can lead to the suffocation of fish and the emergence, and often mortality, of crustaceans such as shrimp, yabbies and crayfish. For example, the Murray crayfish (*Euastacus armatus*), which has an important ecological role in riverine food webs through shredding and processing organic matter like leaf litter, is intolerant of low dissolved oxygen levels. A widespread 'crawl-out' of this species occurred in 1992-93 in the middle River Murray due to a blackwater event. Additionally, high levels of chemicals, such as polyphenols, derived from river red gum (*Eucalyptus camaldulensis*) leaf litter are often associated with blackwater events in south-eastern Australian systems can also be toxic to native fish. Although blackwater events are thought to be responsible for numerous fish kills in Australian lowland rivers and streams, little is known about the long-term effects of these events on freshwater fish and crustacean communities.

Comparison of water from Keyes Point (left) and blackwater from Tarmo (right), Barmah Forest, Victoria. Photo: Keith Ward

The importance of flows and regular flooding

The diversion and anthropogenic use of rivers for purposes such as irrigation can draw-down water levels and alter flood regimes. This less frequent flooding leads to less frequent flushing of organic matter from dry river channels and floodplains. When floods do occur in these systems more organic material is introduced to the river than otherwise would have been if smaller, more frequent floods were occurring; this can then lead to an increased likelihood of a blackwater event occurring. Although blackwater events do occur naturally, anthropogenic activities that alter the frequency of flushing and flooding may therefore lead to more frequent and severe blackwater events.

A major blackwater event – the River Murray

Following the drought-breaking 2010-11 floods a large blackwater event affected approximately 1800 km of the River Murray channel as far downstream as Murray Bridge, South Australia. The hypoxic plume was also present at the site of the River Murray outflow into Lake Alexandrina (near the Murray terminus) from December 2010 until March 2011. At this time, hypoxic conditions were also recorded in the lowland reaches of all major tributaries in the Murray-Darling Basin (Whitworth *et al.,* 2012). Prior to these flooding events prolonged drought (i.e. the Millennium Drought of 1997-2010) combined with restricted environmental flows had allowed large amounts of organic material to accumulate. Following flooding this material was rapidly introduced into the river system resulting in large blackwater events and fish kills.

Although a full assessment of fish and crustaceans mortality was not practical due to the scale of the event (Whitworth *et al.* 2012), these floods led to widespread fish kills. For example, hundreds of dead crustaceans and fish were reported washing up on river banks in Renmark, South Australia. A study tracking the movements of Murray cod (*Maccullochella peelii*) in the Lower River Murray at the time of this blackwater event also noted an increase in mortality of large individuals. Additionally, hypoxic conditions persisted in parts of the River Murray system as late as April 2011, i.e. seven months after the initial flooding in September 2010 (Whitworth *et al.* 2012). This suggests that large blackwater events could have long-term effects on the health of river systems and their biota.

Conclusion and the Way Forward

Although large blackwater events can have negative ecological consequences, the regular addition of small amounts of organic material via leaf litter to river systems is vital for their ecological functioning and health (Robertson *et al*. 1999). Therefore the clearing of riparian and floodplain vegetation (and the subsequent prevention of organic matter build-up) as a means of preventing blackwater events should *not* be considered. This is even more critical due to the loss and dieback of floodplain trees caused by historic clearing, rising soil and groundwater salinity, inappropriate flow regimes and climate change. Over the last decade or so, surveys have revealed serious declines in condition of river red gum and black box across the Murray-Darling Basin, with up to 80% stressed or dead trees in many places (e.g. MacNally *et al.*, 2011).

Murray crayfish escaping the blackwater in the Murray River below mouth of Broken Creek, Barmah Forest, Victoria. Photo: Keith Ward

Importantly, for regulated river systems, well-considered and appropriate timing of environmental flow releases may help to prevent blackwater events (Hladyz *et al*. 2011). For example, small, regular flows and the avoidance of large releases following peak litter-fall, particularly following prolonged dry periods or drought, could help to prevent the build-up of large amounts of leaf litter and the likelihood of deleterious blackwater events occurring in the future.

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An associated bibliography for this article can be obtained by contacting the authors for text with citations and a full reference list. Four key references are listed below:

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Further field observations on the endangered and data deficient *Pultenaea* sp. 'Olinda'

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Introduction

Pultenaea sp. *'Olinda' (Fabaceae)* was listed as endangered in 1998. In an earlier article published in *Australasian Plant Conservation* 22(1) (Clarke 2013), I outlined some preliminary comments on the fire ecology of this species based on observations made during extensive bushwalking trips throughout much of its distribution. Here I wish to provide comments on the distribution, population size and broader aspects of the species' ecology as a further step towards addressing the deficiencies currently hindering the development of a recovery strategy for this species.

Distribution and population size

Pultenaea sp. *'Olinda'* is restricted to a small area east of Rylstone, NSW, measuring approximately 20 km by 6 km. As currently understood, the distribution is divided into two sections. The overwhelming majority of sites and individuals occur in the southern section centred on Currant Mountain Gap, while in the north seven small sites are known in the Spring Log Ridge and Coxs Crown area. Around Currant Mountain Gap, the distribution extends from the head of Brymair Creek east of the Capertee Valley, north to the Hopping Harrys Hollow and Swampy Creek areas. It is not yet known if these two sections represent the extremities of a continuous distribution or if the seven northern sites are a disjunct occurrence. Suitable habitat between these sections appears to be very limited and extremely patchy so any connectivity between them is likely to be very tenuous. Several of these habitats have been examined without success.

Sixty six sites are now known with a total estimated population of 388 plants. While I have traversed extensive areas of the known distribution, there remain a small number of unexplored pagoda habitats where further sites are likely to be found.

Habitat

Pultenaea sp *'Olinda'* is confined to ledges and clefts associated with pagoda rock formations in Triassic Narrabeen Sandstone where it occurs as a component of dry, sclerophyllous heath. Within these habitats it grows in shallow pockets of sandy, infertile soil or directly from cracks and fissures in bare rock. It is possible that plants growing in soil are also exploiting cracks in the underlying rock. 'Harvesting' and funnelling of rainwater into soil pockets and fissures by expanses of bare rock may improve germination and assist ongoing plant survival. It is not uncommon to find plants crowded along and overhanging cliff edges in open sites or around the top of nick points ([dry] waterfalls) in steep slots. It is possible the plants are exploiting higher light availability in these situations. Solitary plants are often found growing on ledges and from cracks on otherwise bare rock faces. All known sites occur between approximately 700 – 850 m elevation. Sites have been found in a wide range of aspects.

Heath communities containing *P.* sp. *'Olinda'* vary in structure from low (1-1.5 m) and open to medium (2-3 m) and dense reflecting variables such as elevation, aspect, slope, depth of soil and time since fire. Observations show *P.* sp. *'Olinda'* regularly attains a height of 1.5 m and occasionally 1.75-2 m.

Floristic composition is also variable and possibly reflects a similar range of environmental variables. Some sites occur beneath a sparse canopy of *Eucalyptus* species and/or *Callitris endlicheri.* Understorey species commonly associated with it include *Acacia obtusifolia*, *A. hamiltoniana*, *A. terminalis*, *Brachyloma daphnoides*, *Dracophyllum secundum, Epacris reclinata, Goodenia decurrens*, *Isopogon dawsonii*, *Leptospermum sphaerocarpum*, *L. arachnoides*, *L. parvifolium*, *Leucopogon muticus*, *L. microphyllus*, *Ochrosperma oligomerum*, *Platysace lanceolata*, *Pimelea linifolia* subsp. *linoides*, *Prostanthera hindii* and *Stylidium laricifolium.* It also occurs with several species of conservation significance including *Grevillea evansiana*, *Leionema sympetalum* and *L. lamprophyllum* subsp. *orbiculare.* Recently (December 2012 and June 2013) it has been found growing with the endangered *Baeckea kandos* (R. Johnstone and S. Clarke pers obs). Heath communities containing *P.* sp. *'Olinda'* resemble Narrabeen Pagoda Rocky Heath-Scrub and Talooby Pagoda Rocky Heath-Scrub as defined and mapped by Bell (1998).

Pattern of occurrence

Pagodas do not occur continuously across the landscape but in discreet 'swarms'. Furthermore, not all pagoda swarms within its distribution contain sites supporting the species. Consequently the occurrence of *P.* sp. *'Olinda'* across its distribution is very patchy. Numbers of individuals per site are small, typically 1-10 plants. Sites containing 20-30 plants have been recorded but are rare. The highest number of plants recorded per site have been due to post fire seedling emergence boosting the typically low number of (resprouting) adults.

Pagoda 'swarm'. Typical habitat of Pultenaea *sp. 'Olinda'. Photo: Steve Clarke*

Seed dispersal

Primary seed dispersal appears to be passive and it is not uncommon to find seeds sitting loose within fruits after dehiscence. The presence of an aril suggests ants may play a role in secondary dispersal but this has not been observed by this author. As passive and ant dispersal are generally limited to a distance of a few metres from the parent plant, this raises an interesting question. How did *P.* sp. *'Olinda'* spread between pagoda swarms that are separated by up to several kilometres of unsuitable habitat? Could birds attracted by the arils and later regurgitating or voiding the seeds intact be responsible for longer distance dispersal as is known to occur in other *Fabaceae*? While a range of small avian species could be considered as potential dispersal agents of *P.* sp. *'Olinda'* seeds, the Origma (*Origma solitaria*) may be a key disperser. This small bird spends much of its time foraging amongst crevices and gaps, along ledges and over areas of bare rock in search of invertebrates and seeds. It is commonly seen foraging in pagoda swarms in close proximity to *P.* sp. *'Olinda'*.

Threats

Of the 66 sites and 388 plants known, only 36 sites (54.5%) and 177 plants (45.6%) occur in a conservation reserve (Wollemi National Park). The remainder occur in state forest, vacant crown land and private property. While areas outside the reserve system are not managed specifically for conservation purposes, the rugged and relatively inaccessible nature of its habitat does offer a degree of protection regardless of land tenure. However, loss of connectivity between pagoda swarms may affect the movement of pollinators (identity unknown) and seed dispersal agents. This could result in genetic isolation and declines in genetic diversity. Domestic/feral goats pose a threat through grazing, trampling and habitat degradation. This has been observed in the sites near Coxs Crown.

Despite the recent increase in known sites, total population size remains very low. The degree of genetic diversity across the species may also be low. Lack of recruitment across the entire distribution (apart from those sites burnt in 2009/10), is concerning. Whether this is indeed the result of an artificial recruitment limitation imposed by current fire management as previously speculated by this author requires investigation. Field observations, however, suggest that we should not protect sites containing old woody plants (indicating a long absence of fire) from fire as a perceived conservation measure. Quite the contrary!

Acknowledgements

Sandra King and Paul McKendry provided companionship, valuable assistance and insightful discussion on the many bushwalks during which these observations were made.

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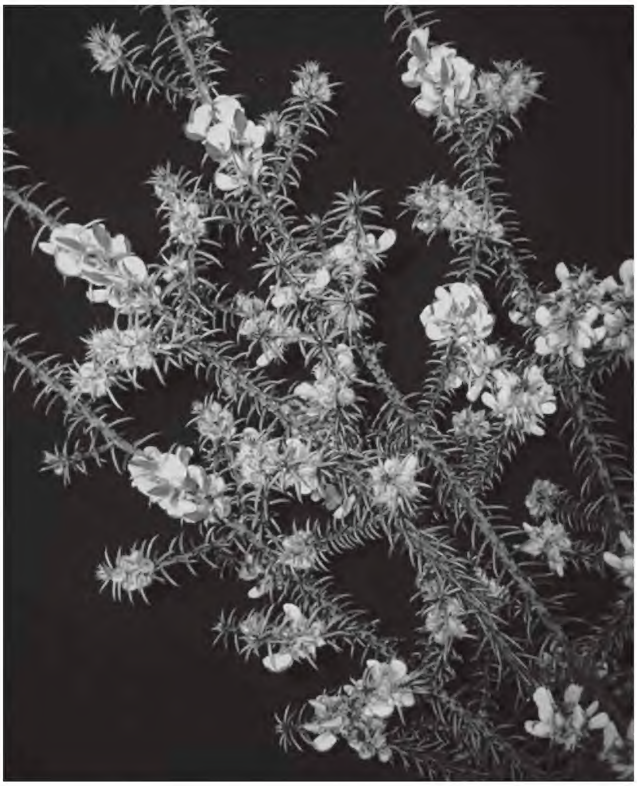

Pultenaea *sp. 'Olinda' Photo: Steve Clarke*

Restore and Renew NSW: Practical provenance and fitness information for restoration practitioners

Maurizio Rossetto[1] *and Tricia Hogbin*[2]

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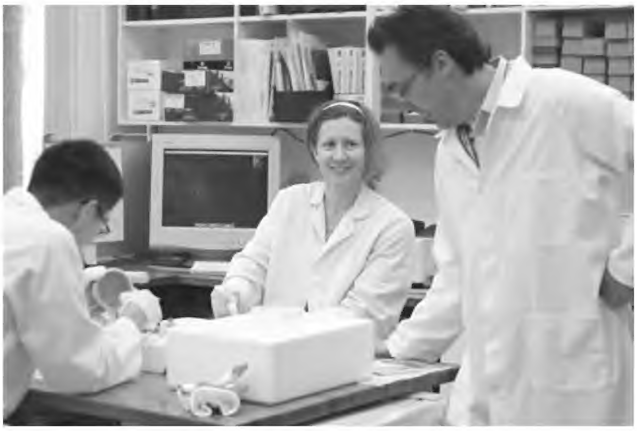
An important consideration in any restoration project is where to source seed and other plant material to be planted on selected sites. Similarly, evaluating how to store and germinate seed can have a profound impact on long-term success. Despite the importance of these decisions, obtaining the necessary information can be challenging.

The Royal Botanic Gardens & Domain Trust (RBG&DT) is hoping to co-ordinate a flagship project that will overcome some of the limits to effective decision-making in ecological restoration projects. The Restore and Renew NSW project aims to provide an easily accessible source of evolutionary, functional and environmental data directly relevant to the NSW flora.

Restore and Renew NSW aims to take advantage of newly developed technology and economy of scale to obtain genetic, environmental and ecological information for around 200 plant species considered as primary targets in restoration projects across NSW. The resulting information will be publically available through a practitioner-friendly website.



The Royal Botanic Gardens and Domain Trust laboratory. New technologies provide an opportunity to obtain large amounts of highly informative genetic data rapidly and cost effectively. Image: Tricia Hogbin

When complete, the Restore and Renew NSW website would function as a tool that practitioners could use to insert the location of their restoration site and the name of their target species, to obtain relevant information including:

- where current and future climate conditions are likely to suit the species
- where to source relevant material, and what sampling strategy to target
- ex-situ seed storage
- seed germination guidelines.

Although the project is at the early pilot stage of development and is dependent upon securing sufficient practical and financial support, the latest generation technology is available and we have started collating relevant background information.

A survey of species commonly used in restoration across NSW

The Australian Network for Plant Conservation (ANPC) is working with RBG&DT to identify the 200 plant species considered most useful in restoration projects across NSW to be included in the Restore and Renew NSW project.

The initial stage of this project is an online survey targeted at anyone involved in native vegetation restoration projects in NSW, including: restoration practitioners, bush regenerators, community volunteers, growers, seed collectors, regulators, licensors and researchers.

Through this survey, respondents have an opportunity to influence which species are included in the resulting Restore and Renew NSW website. Survey respondents will go in a draw to win a one year individual or community group membership to the Australian Network for Plant Conservation (ANPC), valued at up to $105. The survey can be found at https://www.surveymonkey.com/s/ANPC2013 and closes Friday 29th November.

Further information on the project can be found at: http://anpc.asn.au/projects/RestoreNSW.html

Member profile

ANPC member profile – David Taylor

Workplace: Australian National Botanic Gardens (ANBG), Canberra
Role: Curator of the Living Collection

What projects are you working on at the moment?

One of the major projects I'm working on at the moment is the new Red Centre Garden at the ANBG. Construction is nearly finished and it's due to open later this spring. We are planting a diverse range of plants that originate from the arid interior of Australia including threatened, iconic, weird and wonderful, and typical species. It is going to be very interesting as there are many species we haven't planted before at the ANBG, as well as a lot of ephemeral plants which will come and go, in keeping with the boom and bust nature of Australia's red centre. What's really exciting is that we have collected and assembled the ingredients of the landscape too - the rocks, red soil and sands which are such a typical and memorable part of the central Australian landscape. To add a human dimension, we are also telling plant stories originating from people who live in and know 'Red Centre Country '

Of particular relevance to ANPC, I'm also working as part of a team on the Seed Production Area (SPA) Project with Greening Australia and CSIRO. With funds from a Caring for our Country Grant, we are doing chromosomal sampling, germination testing and undertaking comparative work on various SPA techniques, further refining, documenting and testing the SPA model. The aim is to share the results with a wide audience and contribute to the ongoing development of SPA's as an industry, thus reducing the pressure of collecting seed from wild populations. We are currently comparing the results of the different techniques and hope to publish this soon in APC and on the ANPC website.

How long have you been involved in the ANPC?

I've been involved in the ANPC for 4 years now as a committee member, and see my role as providing ongoing support to the ANPC office as well as an important connection between the ANPC and the ANBG - where the ANPC originated 22 years ago!

How did you end up working in plant conservation?

I remember having a very early interest in the bush as a child growing up in Canberra. My parents took me on many trips to nature reserves and I was intrigued by all the ingredients of the bush – the plants, the rocks, the land formations. The fabric of the natural landscape was always an attraction and this resulted in a keen interest in landscape design and construction. So after school, I did a Horticultural Certificate and then worked in the nursery trade for a few years where I was mainly involved in the propagation of native plants. I have been working at the ANBG for 13 years now, starting initially as a gardener and then a horticultural manager which gave me valuable experience in what happens on the ground in such a diverse and challenging, but very rewarding environment.

Are you involved in any conservation activities in your spare time?

About 13 years ago I bought a block of land out at Gundaroo which has good remnants of the endangered Natural Temperate Grassland and Yellow Box-Red Gum Grassy Woodland ecological communities that were fortunately not too degraded by past grazing or pasture improvement. I've put in a lot of work to control weeds such as Serrated Tussock, Sweet Briar, Blackberries and Willows, however my attitude to weed control has changed over the years. Initially I wanted to eradicate the weeds straight away but then started noticing that some species provided good habitat for small woodland birds. So now I am removing them gradually from small areas and at the same time replacing them with native plants propagated from local seed, to maintain bird habitat through the transition.

Although the block was cleared a long time ago, a few trees remain and many seedlings are regenerating on their own now that exotic animal grazing has been excluded. I only need to plant trees where I really want them. For example I plant eucalypts and acacias as woodlots with the aim being to be self supporting in providing our own timber for fuel. I am trying to reach a balance between being an ecological custodian of the land and using it for my own purposes.

I have been working collectively with other landholders in the area as well, looking at how they can use the land the way they want to and have their biodiversity too. I have found that people are often very keen to do this but just don't know how. One way we are doing this is through working with individuals and authorities to incorporate environmental aspects into fuel reduction activities and reach a better compromise between safety and conservation – for example, only clearing large logs on the ground around assets you want to protect and leaving the rest for fauna habitat. There has recently been a few mosaic environmental burns in the district too, the biggest challenge being timing and weather conditions, but we are all learning from the experience.

On another note, a few years ago I built an exclusion fence around the house block to keep out the snakes (I found a brown snake in the house once when my children were small!). The fence also happens to keep out the rabbits, hares, kangaroos and the odd stray sheep. And I've really noticed the difference in the groundcover vegetation between both sides of the fence. Inside the fence many native soft herbs and forbs which I thought were long gone have returned and are flourishing, and the birdlife in the garden has also increased.

What's really exciting is that I found two plants of the threatened Large-headed Groundsel *Senecio macrocarpus* on our block which is the first and only known recording in NSW! We have harvested seed from these plants and working with Rainer Rehwinkle and the ANBG, have translocated eight specimens to the new McLeods Creek Nature Reserve next door. This is allowing us to do some research on the plant whilst reducing the risk of it disappearing altogether. *Senecio macrocarpus*, listed as Vulnerable under the federal *Environment Protection and Biodiversity Conservation Act 1999*, is otherwise only found in Victoria and South Australia. But who knows how many other populations exist between here and the Victorian border!

Report from New Zealand Plant Conservation Network

Alex Fergus

Email: afergus@doc.govt.nz; NZPCN website: www.nzpcn.org.nz

Network launches national endowment fund for plant conservation

The Network launched an endowment fund in late May to resource plant conservation action including fencing, weed control, animal pest control, monitoring, translocation and advocacy. The fund has been created in response to the continuing decline in support for central government agencies involved in plant conservation, and the proposed changes to legislation (such as the Resource Management Act and the Local Government Act) that are likely to affect New Zealand's ability to protect its environment. The new endowment fund is intended to provide sustainable support for plant conservation independent of government or other influences. Donations to the fund can be made here: http://www.nzpcn.org.nz/nzpcn_donations.aspx. Please contact the Network (info@nzpcn.org.nz) if you have ideas of how to raise money for this fund. Thanks to many generous donors, as of 1 September the fund totals almost $13,000, a great result for the first three months of fundraising. The fund will not be used (grants will not be drawn down on the fund) until it reaches more than $50,000.

NZPCN awards 2013

The prestigious New Zealand Plant Conservation Network Awards are now in their eighth year. We are now calling for nominations for the 2013 awards. The purpose of these awards is to acknowledge outstanding contributions to native plant conservation.

The award categories are:

- **individual** involved in plant conservation
- **plant nursery** involved in plant conservation
- **school** plant conservation project
- **community** plant conservation project
- **local authority** protecting native plant life
- **young plant conservationist of the year** (under 18 years at 30 June 2013).

The awards will be presented at the Network Annual General Meeting to be held in Wellington on Wednesday 6 November 2013.

International champion of plant imagery

The Network now has one of the largest on-line collections of plant images for any national flora in the world! As of 1st September NZPCN has 26,250 images of the New Zealand flora on-line, with an additional 3000 images awaiting confirmation. If you take photographs of plants in New Zealand and have a collection of images on your computer that are not being used then please consider sending them to the Network to load on the website (provided they are accurately identified and preferably have a location and date). A prize will be given to the person who provides the 30,000th image loaded on the Network website. Images can be sent on a CD to the Network at PO Box 16-102, Wellington, or individual images can be sent to info@nzpcn.org.nz

Mobile website live!

The Network's mobile website went live on 4th September. This project was funded by the Auckland Council. What this means is that when you access the Network website (www.nzpcn.org.nz) from a smart phone (and are within range of internet or phone coverage) then you will automatically be directed to a version of the website that has been optimised for a phone. If you have a smart phone, then please have a play, as all feedback is welcomed. You can now have the flora of New Zealand in your pocket and record phenology observations using the GPS in your phone.

Global Botanic Gardens Congress in Dunedin

Dunedin, New Zealand, is proud to host the 5th Global Botanic Gardens Congress and 6th Biennial Botanic Gardens Australia & New Zealand Congress, at Dunedin Botanic Garden in October 2013. The Congress sessions will be held at the newly refurbished Dunedin Centre in the middle of the city. This unique event will provide an opportunity for delegates from around the globe to review and discuss progress in achieving the aims and objectives of the International Agenda for Botanic Gardens in Conservation and the Global Strategy for Plant Conservation.

The 5th Global Botanic Gardens Congress will include a wide-ranging programme of plenary keynote addresses, symposium and workshops that will cover the challenges and achievements of botanic gardens and partner organisations around the world. 5th Global Botanic Gardens Congress Dunedin: Sunday 20 – Friday 25 October, 2013. For more information, please visit: http://www.5gbgc.com/

Upcoming conferences and workshops

Global Botanic Gardens Congress in Dunedin

20-25 October 2013
Dunedin Botanic Garden, New Zealand

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8th National Stipa Native Grasslands Conference

5-8 November 2013
Murray Bridge, South Australia

The theme of the conference is the _Potential of Native Grasses_ and is aimed at farmers and property managers. The conference will combine scientific knowledge and practical demonstrations that will assist delegates to regenerate perennial native grasslands on their farms or properties, and learn how to assess if profitable regeneration of native grasses will suit their farm.

The combination of speakers will put in context the incredible importance of fully functioning native grasslands to provide food and biodiversity benefits. For more information, visit https://sites.google.com/site/nationalgrasslandsconference/home

Upcoming conferences and workshops (cont.)

22nd NSW Coastal Conference
Valuing our Coastal Zone, Planning our Future, What's the big picture?

12-15 November 2013
Glasshouse, Port Macquarie, NSW

The 2013 conference program will focus around strategic planning, the values of the coastal zone, technology, community engagement and coastal infrastructure. The conference commences with an optional arrival drink on the Tuesday evening and with the main conference session beginning on Wednesday morning. The conference will incorporate plenary sessions, concurrent sessions, field trips (addressing some of the local coastal, estuary and marine management issues), networking events and the Annual NSW Coastal Management Awards.

The annual conference attracts delegates - who are interested in or working within the field of coastal and estuary management research, education and service provision and policy; - as well as representatives from government, industry, business, user groups and community volunteer organisations.

The Annual NSW Coastal Management Awards will be presented at the conference dinner. These Awards are presented to publicly recognise and acknowledge the contributions of individuals, groups, organisations and agencies toward the ecologically sustainable management of the NSW coastal zone. Nominations are now open via the NSW Coastal Conference website.

Integrating Biodiversity Outcomes with Streamlined Planning
Achieving integration of biodiversity outcomes

26-27 November 2013
Sydney, NSW

Balancing biodiversity conservation outcomes with social and economic priorities is a complex and challenging task. To address this challenge, streamlined planning processes are aimed to support urban and regional growth whilst protecting biodiversity. Hear presentations from federal and state governments on streamlined planning reforms, and case study examples of frameworks and practices for integrating biodiversity outcomes. This conference will provide:

- an understanding of streamlined planning reforms
- strategic approaches & frameworks to integrate biodiversity outcomes
- tools for determining, implementing & managing biodiversity offsetting
- strategies to protect & manage matters of national, state & local environmental significance.

Further information visit http://biodiversityoutcomes.com/

HAVE YOU SUBSCRIBED TO ANPC NEWS?

Keep up to date with the latest news about plant conservation in Australia by subscribing to ANPC's email newsletter - ANPC News. Details of upcoming events, resources, funding opportunities, courses, and volunteering opportunities will be emailed to you every 2-4 weeks.

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The ANPC welcomes contributions to ANPC News. Email your news to anpc@anpc.asn.au with "For ANPC News" in the subject line. Please keep your news item concise (<250 words) and preferably provide a link that readers can click to for further information.

Book reviews

Flora of the Otway Plain & Ranges 2: daisies, heaths, peas, saltbushes, sundews, wattles and other shrubby and herbaceous dicotyledons

by Enid Mayfield
CSIRO Publishing, 2013
436 pages, with colour illustrations
Paperback ISBN: 9780643098060,
Price: AU $ 59.95
Available from http://www.publish.csiro.au/pid/6521.htm

FLORA OF THE OTWAY PLAIN & RANGES 2
daisies heaths peas saltbushes sundews wattles and other shrubby and herbaceous dicotyledons
Enid Mayfield

Flora of the Otway Plain & Ranges 2 is a guide to 480 of the most common daisies, heaths, peas, saltbushes, sundews, wattles and other shrubby and herbaceous dicotyledons that are to be found in the Otway Plain and Ranges.

The book is structured simply and logically with no excess text or unnecessary sections. After the acknowledgements and foreword, the book begins with a self-explanatory chapter titled 'How to use this book'. The second chapter presents a 'Quick plant finder' which lists species under common and scientific name and family allowing for quick reference. An illustrated guide to the 'Characteristics of families' follows which provides an overview of the key features of the plant families covered in this book from the Adoxaceae to Zygophyllaceae. A short illustrated depiction of the 'Characteristics of dicotyledons' is then presented which provides a concise summary of what makes a dicotyledon a dicotyledon.

As this book is a field guide, the remainder of the book contains the illustrated guide to species. It is in this section that this book really shines. The section is arranged alphabetically by family, genus and species which allows for effortless navigation. When using this book, one can pick up a plant in the field from a known family and flick to the corresponding section of the book and compare related species to quickly obtain identification. The descriptions of species are clearly expressed in typical clear botanical language common to all good field guides. The colour illustrations highlight important plant features (habit, leaves, flowers and fruits or seeds) to aid in species identification. The origins of scientific names are provided for each genus and species which is a neat feature. A comprehensive illustrated glossary is also provided at the end of the book that functions as an invaluable reference to aid in plant identification.

While the geographic focus of the book is clearly on the Otway Plain, Otway Range and the Warrnambool Plain, this guide will also be useful throughout Victoria and neighbouring states where vegetation types such as tall wet sclerophyll forest, cool temperate rainforest, open heathland, temperate open forest and grassy woodlands, coastal dunes, and inland plains are found.

I use books like this in my work to assist with plant identification. With features including visual family keys, species descriptions arranged by family, and excellent illustrations of genus and species characteristics, this book is an invaluable tool. I recommend this book to professional and amateur botanists, naturalists, bushwalkers and anyone wishing to identify the plants of the Otway plain and ranges.

Lukas Clews, Parsons Brinckerhoff, Melbourne Vic

Estuary plants and what's happening to them in south-east Australia

by Geoff Sainty (editor)
Publisher: Sainty and Associates, 2012
656 pages, with photographs, maps, illustrations
Hardback ISBN: 9780958105538
Price: AU $ 85.00
Available from http://www.publish.csiro.au/pid/7116.htm

estuary plants and what's happening to them in south-east Australia

Estuarine and coastal plants are vital to the stability and ecological diversity of the Australian coast and provide substantial ecosystem services, such as: buffering the coast from storms, productive coastal fisheries, unique biodiversity, nutrient cycling, cleaner coastal waters, and 'blue' carbon (i.e. the sequestration of greenhouse gases into coastal sediments and plants).

Estuary Plants and What's Happening to them in South-east Australia is a timely addition to the 'practical' coastal ecology library. The book is about plants that grow in estuaries and protected saline places along coastal south-east Australia (Victoria and New South Wales, specifically) and the ongoing anthropogenic impacts to these systems. It is both a field-guide and a valuable synthesis of current knowledge, and is a must-have for anyone interested or working in this field.

Book reviews (cont.)

Edited by four professional stalwarts of the coastal and estuarine scene, Geoff Sainty, John Hosking, Geoff Carr and Paul Adam, this book also boasts contributions from a host of other top-notch experts (36 to be precise) in the related fields of estuarine/coastal botany, biodiversity, ecology and management.

The book is divided into two parts. The first part (some 400 pages) focuses on the estuary plants themselves. It is preceded by an introductory section that sets the scene regarding the importance of, and threats to, estuary/coastal plants. The chapter-like sections deal with each major taxonomic/habitat group, beginning with micro-algae and working through macro-algae, seagrasses, mangroves, saltmarsh, brackish and fringing plants. It concludes with overview and inventory sections specific to Victoria (a similar inventory for NSW would have been a bonus here).

The format of each plant taxa section has the nature of a 'field-guide' with a layout that aims to help with the identification of the various plant species (this is particularly useful for the layperson). Each species has summarised text (about half a page or less) that includes: nomenclature, anatomical description with key features, and further notes on 'value' and seasonal aspects.

A national distribution map is also provided for each species (note many species also occur in the other parts of Australia, i.e. beyond the scope of the book), along with a very neat indicator graphic of the amount of waterlogging and salinity the plant prefers/experiences. Both these graphics are extremely innovative and useful features of the book. The photography that supports the text for each species is magnificent. It clearly demonstrates the habitat provided by the plant, and the characteristic aspects of individuals, such as stems, leaves, flowers and fruiting bodies –many of which are magnified so as to further aid identification.

The second part of the book (some 230 pages) provides an up-to-date treatise on 'what's happening' to the plants and the habitats they create – again with excellent and well considered photographs and diagrams throughout. It consists of 22 mini-chapters or sections by experts on various topics, many of which have practical application in the field. Example topics include those related to: specific case studies from Victoria and New South Wales, specific threats, management, mapping, rehabilitation, related fauna, and community engagement. Some of the specific threats dealt with include: algal blooms, climate change, sea level rise, pollution, and boating.

Of particular interest are the sections dealing with detecting and understanding environmental impacts, and rehabilitation. The latter also includes practical advice, for example, regarding translocations of various species and practical barriers to halt the growing problem of mangrove transgression into saltmarsh. The section on sea level rise is one of the most informative and interesting I have seen, and importantly provides more detail on methane than is typically encountered.

In addition to a 'traditional' index and glossary, the book concludes with a one page 'pictorial' glossary which shows the different leaf shapes, bases, venations, margins and arrangements of plants, their flower parts and habitats; the page also has a graduated ruler along the outer-edge (another handy tool for the field).

As stated above, overall this is a must-have book for those with a practical interest in coastal botany, ecology and management. It is an excellent reference source for the laboratory or office. However, if it were to go to another print-run, the editors might consider that it may enhance the field-guide nature of the product to produce something like a compendium in two separate parts – and perhaps a little larger (page dimensions) with spiral binding for ease of use. As it is now, the book is quite a small-sized but heavy tome!

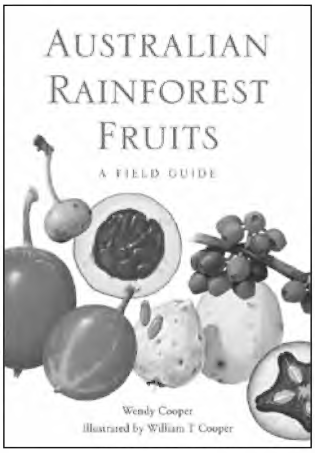
Dr Gina Newton, Canberra ACT

Book reviews (cont.)

Australian Rainforest Fruits, a field guide

by Wendy Cooper, Illustrated by
William T Cooper
CSIRO Publishing, 2013
272 pages with colour plates, line art, maps
Paperback ISBN: 9780643107847
Price: AU $ 59.95
Available from http://www.publish.csiro.au/pid/6968.htm

To a Brush Turkey this delicious little book is like one of those glossy gourmet books that tantalize the taste buds and inspire us to seek out new gastronomic frontiers.



Although by no means a comprehensive guide to the fruiting rainforest flora of east coast Australia, this is a fantastic resource for those interested in learning more about the families, genera and to some extent the species of fruiting rainforest flora. This field guide covers 504 of the most common fruiting plants found in Australia's north eastern rainforests, as well as species that are rare in the wild but generally well-known. Some of the species included are also found in south east Queensland, but on the whole this is a book about tropical rainforest fruits.

For identification purposes the life sized images of the fruit covered by this guide are arranged according to colour of ripe fruit, then by size and form. The five broad categories - pink to purple, blue to black, yellow and orange to red, green to brown, and white – allow people with even limited botanical knowledge to identify rainforest fruits in the tropics. However keep in mind that if you are in south east Queensland and have found the fruit of a Yellow Carabeen *Sloanea woollsii* and you refer to this guide you could think you have found a White Carabeen *Sloanea langii* (remember to read the distribution information!)

Additional information on each species listed includes a basic species description, accompanied by a leaf drawing, a distribution map, and diagnostic characters to help the reader distinguish between similar species.

If you're a bit of a Brush Turkey like me and love the look of rainforest fruits, learning more about our outstanding and unique rainforests and also the art of William T. Cooper, then this is a must have for the bookshelf!

Spencer Shaw, Brush Turkey Enterprises, Maleny Qld

Contribute further to the conservation of Australia's unique plants by donating to ANPC!

The Australian Network for Plant Conservation mostly relies on membership fees, sponsorship and grant funding to carry out its activities, such as running training workshops, forums and conferences, and publication of *Australasian Plant Conservation*.

Donations to our Public Fund also help, with donations of $2 or more being tax-deductible.
Donate today and help us promote and improve plant conservation in Australia. Go to our website www.anpc.asn.au/Support/Donations.html or tick the donation box when you renew your ANPC membership soon!

Information resources and useful websites

Senate Committee report on Effectiveness of threatened species & ecological communities' protection in Australia

http://tinyurl.com/threatenedspeciesprotection

This report summarises the findings and recommendations of a senate inquiry into the effectiveness of threatened species protection in Australia. Current approaches to threatened species protection are summarised, including the listing process, recovery plans, threat abatement, critical habitat declaration, and regulatory and funding arrangements. The report focusses on Commonwealth policies and regulation, particularly the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and its processes. However, state and territory processes are also considered. 44 recommendations for improving threatened species protection in Australia are identified.

National Climate Change Adaptation Research Facility (NCCARF) publications

http://www.nccarf.edu.au/publications

The NCCARF website provides a range of information products, including research reports, fact sheets, data, presentations and other outputs from NCCARF's research programs. There are over 100 reports from 2013 alone, including useful synthesis reports of climate change adaptation research for each of the states and territories. Each state and territory synthesis report directs users to research relevant identified priorities. Other reports relevant to conservation of Australia's native vegetation include:

- *A risk assessment and decision making framework for managing groundwater dependent ecosystems*
- *Designing landscapes for biodiversity under climate change,* and
- *Increasing the resilience of the Australian alpine flora to climate change.*

Biodiversity Across the Borders conference videos

http://ianluntecology.com/2013/08/03/from-ballarat-with-love-great-biodiversity-videos/

The University of Ballarat hosted a 'Biodiversity Across the Borders conference' 7th June 2013. The theme was 'enhancing ecosystem management and restoration'. Videos of many of the talks have been posted on the University's video site and IanLuntEcology.com includes links to eight of these presentations, including a keynote address by David Lindenmayer on 'Effective ecosystem restoration and management'. Also included is Ian Lunt on 'Natural regeneration: connecting regional Australia' and Alan York on 'Fire, landscape pattern and biodiversity'.

The Matrix in Ecology

http://dondriscoll.wordpress.com/video/

This brief four minute animated video provides a great example of how to disseminate research findings in an appealing and simple format. Based on a recent publication in Trends in Ecology and Evolution, the video introduces the concept of the matrix in fragmented landscapes, and explains how it influences species that depend on remnant vegetation.

Research round up

Compiled by Kirsten Cowley, Centre for Plant Biodiversity Research, Canberra.
Email: Kirsten.Cowley @csiro.au

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Research round up (cont.)

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Contributions to Research Roundup are welcome, and should be sent to Kirsten Cowley at the above email address using an email subject heading "APC Research Roundup" or similar. Their inclusion will be subject to available space.

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Murrumbidgee Catchment Management Authority

Royal Botanic Gardens and Domain Trust, NSW

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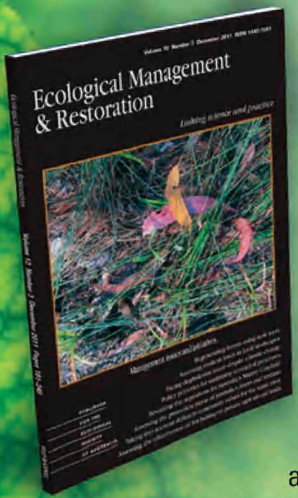

Ecological Management & Restoration

ESA

Project Summary Website

The Australasian journal *Ecological Management & Restoration* has launched a website dedicated to sharing ideas and reporting on interesting ecosystems rehabilitation or restoration projects in Australia.

Project summaries are not peer reviewed manuscripts like EMR, but are checked for clarity and content by the project summaries editor. Final acceptance of projects summaries is at the discretion of the editor.

For more information visit: www.emrprojectsummaries.org

Ecological Management & Restoration is a peer-reviewed journal dedicated to promoting improved ecosystem management and restoration within the context of ecologically sustainable utilisation.

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WILEY

Australian Network for Plant Conservation, Inc

presents a workshop on

Plant identification for flora of the Wimmera

Horsham, Victoria
30th – 31st October 2013

This two day workshop will introduce participants to the plant communities and threatened flora of the Wimmera region and provide the skills and information required to positively identify a range of common plants.

For further information, including a full program and registration details, visit the ANPC website www.anpc.asn.au and click on courses and workshops. Alternatively contact the ANPC national office on anpc@anpc.asn.au or (02) 6250 9509.

Wimmera CMA

LANDCARE
WIMMERA

Are you involved in native vegetation restoration in NSW?

We are seeking restoration practitioners, bush regenerators, community volunteers, growers, seed collectors, regulators, licensors and researchers to complete our survey.

We wish to identify around 200 plant species considered most useful in restoration projects across NSW to be included in a new Restore and Renew NSW project.

Restore and
Renew NSW

The Royal
Botanic Gardens
& Domain Trust

The Restore and Renew NSW project aims to provide an easily accessible source of evolutionary, functional and environmental data directly relevant to restoration of the NSW flora.

Survey respondents will go in a draw to win a one year individual or community group membership to the Australian Network for Plant Conservation, valued at up to $105.

To participate in the survey visit:
surveymonkey.com/s/ANPC2013

For further information and contacts visit:
anpc.asn.au/projects/RestoreNSW.html

Survey closes Friday 29th November 2013